

Docket No.: 491712000100  
(PATENT)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

In re Patent Application of:

Eugene S. SMOTKIN

Application No.: 09/891,200

Filed: June 26, 2001

For: ELECTROLYTE COMPONENTS FOR USE  
IN FUEL CELLS (AS AMENDED)

Confirmation No.: 9382

Art Unit: 1745

Examiner: Raymond Alejandro

**PETITION UNDER 37 C.F.R. § 1.181**

MS Appeal Brief – Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

Appellant requests that the Appeal Brief filed 11 July 2007 or in the alternative the Substitute Appeal Brief filed 3 October 2007 be retained as the Appeal Brief before the Board in the above-referenced case. These briefs differ only in the section relating to the Summary of the Invention.

Statement of Facts

Appellant filed a Substitute Appeal Brief on 11 July 2007 with the Summary of the Invention set forth in Exhibit A. A Notice of Non-Compliant Brief complained that there was subject matter included in the Summary not relevant to the claims. In response, appellant filed a Substitute Brief on 3 October 2007 with the Summary of the Invention enclosed as Exhibit B.

Another Notice of Non-Compliance was mailed on 21 November 2007 again objecting to the Summary of the Invention as containing assertedly irrelevant subject matter. In response to this notice, a Substitute Summary of invention taken alone in accordance with MPEP § 1205.03 is being submitted concurrently herewith. This is attached as Exhibit C.

Appellant believes that all three of the proposed texts for the Summary of Invention are in compliance with 37 C.F.R. § 41.37(c)(1)(v). Appellant sees nothing in this section which precludes the appellant placing the invention in context and providing explanatory material as to the limitations in the claims as long as the support for the claims in the specification is identified. Appellant recognizes that the explanation is required to be “concise” but believes that an explanation that occupies only slightly more than three pages in the Brief filed 11 July 2007 and occupies only slightly more than two pages in the Brief filed 3 October 2007 fulfills the definition of “concise.”

Respectfully, appellant believes that requiring a summary of the form set forth in Example C unfairly prejudices appellant’s ability to explain the invention to the Board. Accordingly, appellant requests that either the Brief filed 3 October 2007 or filed 11 July 1007 be retained as appellant’s Brief before the Board. Appellant has no objection to utilizing the Summary of the Invention as set forth in Example C to supplement these briefs.



**1. Real Party in Interest**

The Real Party in Interest is the assignee herein, NuVant Systems LLC, a California corporation.

**2. Related Appeals and Interferences**

None of appellant, appellant's legal representative or assignee is aware of any prior or pending appeals, interferences or judicial proceedings that would be related to or otherwise affect the Board's decision in the pending appeal.

**3. Status of Claims**

This application was originally filed with 62 claims, all of which have now been canceled. Claims 63-74 were added in response to an Office action, response to which was filed 25 November 2003. These claims were canceled in response to the next Office action, which response was filed 23 July 2004, and claims 75-92 were added at that time. After filing an RCE, claims 75-92 were entered, but claims 83 and 92 were withdrawn from consideration. Claims 83 and 92 were canceled in a response filed 21 June 2005.

Thus, claims 1-74, 83 and 92 are canceled and claims 75-82 and 84-91 are pending and are on appeal.

**4. Status of Amendments**

There were no amendments proposed subsequent to final rejection in this case.

**5. Summary of Claimed Subject Matter**

Claims 75 and 84 are independent, and are alternative approaches to claiming similar subject matter.

The invention solves the problem of constructing electrolytes for fuel cell membrane electrode assemblies (MEA) that will operate at higher temperatures than those conventionally used. As explained on page 3 of the specification at lines 15-20, in conventional fuel cells, reactions are catalyzed on each face of a generally two-dimensional membrane that operates as the electrolyte. In order to function as an electrolyte in a fuel cell, such electrolytes must be electronically insulating but proton-conducting (EIPC) (see page 14, lines 10-11). The conductance of protons through the EIPC component must be sufficient to let the fuel cell of which the membrane electrode assembly is a member operate successfully.

The conductance can be calculated as the area of the electrolyte perpendicular to the flow of protons divided by the area specific resistance (ASR). (See the declaration of Dr. Smotkin submitted 9 January 2006, which outlines this textbook material.) Thus, the ASR, which is dependent on the thickness of the EIPC, must be sufficiently low to be workable in the fuel cell. A suitable range for of ASR protons as set forth on page 17, lines 3-4, is about  $0.01\text{-}100\ \Omega\cdot\text{cm}^2$ . A satisfactory level of proton ASR is also that represented by the conventional electrolyte Nafion<sup>®</sup> which operates at relatively low temperatures – *e.g.*,  $80^\circ\text{C}$ , as shown in Figure 10. This shows a similar but narrower and more favorable range compared to that set forth on page 17 – *i.e.*, about  $0.02\text{--}0.15\ \Omega\cdot\text{cm}^2$ . As noted in the application, Nafion<sup>®</sup> is successfully used as a proton-conducting polymer (see page 8, lines 4-9) but must operate at low temperature because the presence of water is required (see page 8, lines 9-14). Claim 75 specifies the area-specific resistance for protons in the above quoted range from page 17 and claim 84 specifies this area-specific resistance as referred to Figure 10. Figure 10 appears as such in the claims.

As noted in the specification on page 9, beginning at line 10, the desirability of having proton conductors working satisfactorily in the range of 200-500°C has been recognized in the art, but no successful electrolyte has been found (page 9, line 16-page 10, line 15). The invention proposes compositions for electrolytes that are workable in this general range. Specifically, as set forth in the claims and as supported, for example, on page 17, line 19-page 18, line 7, the specific temperature range of operability of 220°C-550°C is required. Both claims 75 and 84 require this temperature range.

As noted above, the area-specific resistance (ASR) for protons will increase as the thickness of an electrolyte increases. The data supplied in Norby, referred to on page 7, line 10, *et seq.*, of the present application, presents the conductivity of various materials as a function of temperature. Conductivity, unlike conductance, is an intrinsic property of the material and does not depend on thickness. Norby apparently assumes that the thickness of the EIPC electrolyte conventionally used in fuel cells is a required feature, and if that were true, only materials that had innate conductivities in the “gap” shown in Figure 1 of Norby would be satisfactory. The present inventor understood, as was not appreciated in the art, that in order to bring materials, such as those described by Norby, into a satisfactory level of proton ASR, it would be necessary to reduce the thickness of the electrolyte to such an extent that the electrolyte is no longer self-supporting, *i.e.*, the electrolyte does not remain intact because it is too thin. The present inventor further devised an appropriate solution to this problem by supporting the proton electrolyte on a metal foil.

Thus, this problem, unrecognized in the art, is solved by the invention, as described on page 23 of the specification beginning at line 7, by using a proton-conducting support. Metals or alloys can serve as separators of the fuel and oxygen that are the reactants in fuel cells and they

reversibly absorb hydrogen (see page 23, line 12). Thus, they become hydrides when the cells are in operation (see page 23, lines 14-16). Although they are electronic conductors, this is not problematic because the presence of the electrolyte as an electronic insulator makes this acceptable.

Thus, as set forth in claims 75 and 84, the invention is directed to electron-insulating proton-conducting (EIPC) membranes designed to serve as electrolytes in fuel cells where a single metal or metal hydride support is coated on one or both faces by an EIPC coating that operates at the above-cited temperature range (220-550°C) and at the appropriate proton ASR, *i.e.*, 0.01-100  $\Omega\cdot\text{cm}^2$ , in claim 75 and in the range of Nafion<sup>®</sup> as shown in Figure 10 in claim 84.

The requirement that the EIPC be inorganic is supported on page 28, lines 11-12; additional alternatives are described, but only inorganic EIPC's are claimed. Support for lacking a liquid phase is found, for example, on page 22 at lines 10-12, page 21, lines 15-16, and page 11, lines 9-13, as well as lines 18-19.

Thus, support is found for the independent claims as described above.

The dependent claims simply name various materials that might be used to compose the metal/alloy support and the EIPC. Support for these embodiments is found, for example, on page 23, lines 10-11, with regard to the support, as well as page 27, lines 19-20. The specified EIPC's are found, for example, on page 29, beginning at line 6.

In summary, the invention resides in constructing an electrolyte that is useful in a membrane electrode assembly (MEA) for a fuel cell where operability at high temperatures is provided by use of an electrolyte that is inorganic and lacks a liquid phase. This is made possible in view of the realization by the present inventor that in order to achieve the requisite proton conductance or ASR of such materials, the electrolyte needs to be too thin to stand on its own and thus such electrolytes

must be supported on a metal/metal hydride support. While inorganic electrolytes are known in the art, their conductivity is so low that they have been considered as inappropriate for operation at the required temperatures by the practitioners of the art, as recognized by one of the documents of record herein, Norby. It has been found that satisfactory behavior at the relevant temperature range is only possible at thicknesses of the electrolyte which require such support, and this problem is solved by providing this support.

**6. Grounds of Rejection to be Reviewed on Appeal**

The following grounds of rejection, taken in order, are appealed.

Claims 84-91 were rejected under 35 U.S.C. § 112, paragraph 2, based on objection to the inclusion of a trademark designation and of a figure in claim 84.

Claims 75-76, 80-81, 84-85 and 89-90 were rejected as either anticipated (§ 102(b)) or obvious over Baucke, *et al.*, U.S. patent 5,094,927.

All pending claims, claims 75-82 and 84-91, were rejected as assertedly obvious over Smotkin, *et al.*, U.S. 5,846,669 in view of various secondary documents. These secondary documents are Norby, T., *Solid State Ionics* (1999) 125:1-11 ("Norby"); Crome, *et al.*, U.S. patent 5,985,113 ("Crome"); Ryu, Kwang Hyuan, *et al.*, *Solid State Ionics* (1999) 125:355-367 ("Ryu"); or Lybye, Dorthe, *et al.*, *Solid State Ionics* (1999) 125:339-344 (Lybye).

All claims were rejected as assertedly obvious over WO 98/21777 ("WO '777") in combination with the same secondary documents as those listed above, also listed in the alternative.



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Claims 75 and 84 are independent, and have alternative formulations to describe a single limitation, but claim similar subject matter.

Independent claims 75 and 84, are directed to electron-insulating proton-conducting (EIPC) membranes designed to serve as electrolytes in fuel cells where

- (1) a single metal or metal hydride support is
- (2) coated on one or both faces by
- (3) an inorganic EIPC coating lacking a liquid phase
- (4) that operates at the temperature range (220-550°C) and
- (5) at the appropriate proton area-specific resistance (ASR), *i.e.*, 0.01-100  $\Omega\cdot\text{cm}^2$ , in claim 75 and in the range of Nafion<sup>®</sup> as shown in Figure 10 reproduced in claim 84.

The invention as claimed solves the problem of constructing electrolytes for fuel cell membrane electrode assemblies (MEA) that will operate at higher temperatures than those conventionally used. As explained on page 3 of the specification at lines 15-20, in conventional fuel cells, reactions are catalyzed on each face of a generally two-dimensional membrane that operates as the electrolyte. In order to function as an electrolyte in a fuel cell, such electrolytes must be electronically insulating but proton-conducting (EIPC) (see page 14, lines 10-11). The conductance of protons through the EIPC component must be sufficient to let the fuel cell of which the membrane electrode assembly is a member operate successfully.

As to limitation (4), the specification page 9, beginning at line 10, discloses that the desirability of having proton conductors working satisfactorily in the range of 200-500°C has been recognized in the art, but no successful electrolyte has been found (page 9, line 16-page 10, line 15). The claims require compositions for electrolytes that are workable in this general range. Specifically, as set forth in the claims and as supported, for example, on page 17, line 19-page 18,

line 7, the specific temperature range of operability of 220°C-550°C is required. Both claims 75 and 84 require this temperature range.

As to limitation (3), the requirement in both claims 75 and 84 that the EIPC be inorganic is supported on page 28, lines 11-12; additional alternatives are described, but only inorganic EIPC's are claimed. Support for lacking a liquid phase is found, for example, on page 22 at lines 10-12, page 21, lines 15-16, and page 11, lines 9-13, as well as lines 18-19.

As to limitations (1) and (2), both claims 75 and 84 also require a single proton-conducting support as set forth on page 23 of the specification beginning at line 7. Metals or alloys can serve as separators of the fuel and oxygen that are the reactants in fuel cells and they reversibly absorb hydrogen (see page 23, line 12). Thus, they become hydrides when the cells are in operation (see page 23, lines 14-16). Although they are electronic conductors, this is not problematic because the presence of the electrolyte as an electronic insulator makes this acceptable.

As to limitation (5), both claims require a value for ASR that is practical for fuel cell operation. Claim 75 requires the area-specific resistance for protons in the range of  $0.01 - 100 \Omega \cdot \text{cm}^2$  set forth on page 17, lines 3-4, and claim 84 specifies this area-specific resistance as referred to Figure 10. Figure 10 appears as such in claim 84. The ASR, which is dependent on the thickness of the EIPC, must be sufficiently low to be workable in the fuel cell. A suitable range for of ASR protons as set forth on page 17, lines 3-4, is about  $0.01-100 \Omega \cdot \text{cm}^2$ . A satisfactory level of proton ASR is also that represented by the conventional electrolyte Nafion<sup>®</sup> which operates at relatively low temperatures – *e.g.*, 80°C, as shown in Figure 10. This shows a similar but narrower and more favorable range compared to that set forth on page 17 – *i.e.*, about  $0.02 - 0.15 \Omega \cdot \text{cm}^2$ . As noted in the application, Nafion<sup>®</sup> is successfully used as a proton-

conducting polymer (see page 8, lines 4-9) but must operate at low temperature because the presence of water is required (see page 8, lines 9-14).

Thus, support is found for the independent claims as described above.

The dependent claims simply name various materials that might be used to compose the metal/alloy support and the EIPC. Support for these embodiments is found, for example, on page 23, lines 10-11, with regard to the support, as well as page 27, lines 19-20. The specified EIPC's are found, for example, on page 29, beginning at line 6.

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Eugene S. SMOTKIN

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IN FUEL CELLS (AS AMENDED)

Confirmation No.: 9382

Art Unit: 1745

Examiner: Raymond Alejandro

**SUBSTITUTE SUMMARY OF CLAIMED SUBJECT MATTER**

MS Appeal Brief – Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

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As to limitations (1) and (2), both claims 75 and 84 require a single proton-conducting support as set forth on page 23 of the specification beginning at line 7 to page 24, line 9. Metals become hydrides when the cells are in operation (see page 23, lines 14-16). Support for coating on one or both faces is on page 25, lines 11-19 and page 26, lines 13 to page 27, line 4.

As to limitation (3), the requirement in both claims 75 and 84 that the EIPC be inorganic is supported on page 28, lines 11-12; additional alternatives are described, but only inorganic EIPC's are claimed. Support for lacking a liquid phase is found, for example, page 11, lines 9-13, as well as lines 18-19 on page 22 at lines 10-12, and page 21, lines 15-16.

As to limitation (4), this is supported, for example, on page 17, line 19-page 18, line 7, the specific temperature range of operability of 220°C-550°C is required. Both claims 75 and 84 require this temperature range.

As to limitation (5), both claims require a value for ASR that is practical for fuel cell operation. Claim 75 requires the area-specific resistance for protons in the range of 0.01 - 100  $\Omega\cdot\text{cm}^2$  set forth on page 17, lines 3-4. Claim 84 specifies this area-specific resistance as referred to Figure 10. Figure 10 appears as such in claim 84.

This substitute summary is filed in response to a Notice of Non-Compliant Brief mailed 21 November 2007.

Respectfully submitted,

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